SECTION 02223

BACKFILLING

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Backfill of utility and footing trenches.

B. Site grading fills.

### 1.2 RELATED SECTIONS

A. All sections.

### 1.3 MEASUREMENT AND PAYMENT

A. Section 01800 – Measurement and Payment.

### 1.4 REFERENCES

A. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates.

B. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb Rammer and 12 inch drop.

C. ASTM D4253 - Maximum Index Density of Soils Using a Vibratory Table.

D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

E. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

## PART 2 PRODUCTS

### 2.1 FILL MATERIALS

All fill materials should have a liquid limit (LL) less than 45 and a plasticity index (PI) of less than 25.

A. Clayey subsoil from project excavations or a suitable Contractor obtained borrow site acceptable to the Engineer; free of organic material, gravel, or lumps larger than 3 inch size, and debris.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify stockpiled earth fill material is acceptable to Engineer.

B. Verify stockpiled stone or aggregate to be used is acceptable to Engineer.
C. Verify areas to be backfilled are free of debris, and are acceptable to Engineer.

3.2 PREPARATION

A. Strip all vegetation, topsoil, trash and debris, and grub out all stumps and roots from areas which are to receive fill.

B. Excavate unsuitable areas of subgrade as authorized by Engineer and replace with approved backfill material. Compact to density equal to requirements for subsequent backfill material.

C. Dewater as needed to provide proper conditions during backfilling operations.

D. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING

A. Excavated materials to be sorted and used for backfill in the order it was removed from the excavation. Step or bench bonding surfaces of areas to be filled which are steeper than 2% slope.

B. At locations indicated on the project drawings, or where directed by Engineer, place and compact approved fill materials in equal continuous layers not exceeding 8 inches loose depth.

C. Employ a placement method that does not disturb or damage other work.

D. Maintain moisture content of soil backfill materials between +3% and -1% from the optimum moisture content as determined by ASTM D698.

E. Backfill areas to contours and elevations with unfrozen materials.

F. Make gradual grade changes. Blend slope into level areas.

G. Backfill topsoil in vegetation areas to a six inch depth below finished grade.

H. Remove surplus backfill materials from site.

I. Leave fill material stockpile areas free of excess fill materials.

3.4 TOLERANCES

A. Top Surface of Backfilling Under Pavement and footings: Plus or minus 0.05 feet from required elevations.

B. Top Surface of General Backfilling: Plus or minus 0.15 feet from required elevations.

3.5 COMPACTION REQUIREMENTS

A. Subsoil Fill: Clayey Subsoil as specified, compacted in lifts; not exceeding 8 inches loose depth, to 95% of maximum dry density.

B. Topsoil Fill: Topsoil as specified, compacted in lifts not exceeding 8 inches loose depth, to 85 percent of maximum dry density.

3.6 FIELD QUALITY CONTROL

A. Tests and analysis of in-place fill materials will be performed by comparison to optimum density and moisture conditions as determined in accordance with ANSI/ASTM D698 or ANSI/ASTM D 4253 as applicable.

B. If tests indicate Work does not meet specified requirements, remove work, replace and retest.

C. Proof roll compacted fill surfaces under structures.

END OF SECTION

SECTION 02225

TRENCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavate trenches.

B. Backfilling trenches.

C. Compaction requirements.

1.2 RELATED SECTIONS

A. All sections.

1.3 MEASUREMENT AND PAYMENT

A. Section 01800 – Measurement and Payment.

1.4 REFERENCES

A. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates.

B. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

C. ASTM D4253 - Maximum Index Density of Soils Using a Vibratory Table.

D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

E. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

F. Minor Section 408 - Emergency Action Plan – Missouri River, Council Bluffs, IA, Mosquito Creek Levee, Unit 624, Section 3 – Iowa Communications Network Directional Bore and Trenching for 2" HDPE Duct

1.5 PROTECTION

A. Protect excavations, existing gabions, and other existing structures; by shoring, bracing, sheet piling, underpinning, or other methods necessary to prevent cave-in or loose soil form falling into excavation. Avoid use of trench boxes for temporary excavation support in close proximity to the levee.

B. Underpin adjacent structures which may be damaged by excavation work, including utility lines and pipes.

C. Notify Engineer of unexpected subsurface conditions and discontinue work in affected area until notification to resume work.

D. Protect bottom of excavations and soil adjacent to and beneath pipe or structures from frost.

E. Grade excavation top perimeter to prevent surface water run-off into excavation.

F. Dewater excavations as needed at no additional cost to Owner.

G. In order to protect the integrity of the levee system and properties behind the levee, the contractor must complete the requirements and submittals as outlined in the **Minor Section 408 – Emergency Action Plan**, as referenced in Section 1.4 above, prior to commencing any work on this project. The contractor is responsible for monitoring the river stage levels and following the plan.

PART 2 PRODUCTS

2.1 SELECT BED AND FILL MATERIALS

A. Select Subsoil: from trench excavations, graded free of organic material, gravel larger than 1 inch size, and debris.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify stockpiled fill to be used is approved.

B. Verify subgrade has been inspected and approved.

C. Verify construction material installation has been inspected and approved.

D. Verify areas to be backfilled are free of debris, snow, ice, or water, and surfaces are not frozen.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Compact subgrade surfaces to density requirements for backfill material.

3.3 EXCAVATING

A. Excavation is unclassified.

B. Excavate subsoil required for construction material installation to required grade.

C. Cut trenches sufficiently wide to enable installation of work items and to allow inspection. Comply with manufacturer's recommendations.

D. Hand trim subgrade and leave free of loose matter. Hand cut bell holes for bell and spigot pipe joints to provide uniform bearing of pipe on subgrade.

E. Remove lumped subsoil, boulders, or other unsuitable material.

F. Fill over-excavated areas under construction material bearing surfaces with approved material per Section 02223.

G. Correct unauthorized over-excavation at no cost to Owner.

H. Remove excess subsoil not being reused from the site.

3.4 BACKFILLING

A. Backfill in accordance with requirements of Section 02223 - Backfilling.

B. Support work items to avoid displacement during placement and compaction of backfill material.

C. Properly install and consolidate or compact bedding material required for installation being made.

D. Backfill trenches to prescribed contours and elevations. Backfill systematically, as early as possible, to allow maximum time for any natural consolidation. Do not backfill over porous, wet, or spongy subgrade surfaces.

E. Place and compact select fill material per Section 02223.

F. Maintain optimum moisture content of backfill materials per Section 02223.

G. Remove surplus backfill materials from site.

H. Leave stockpile areas completely free of excess fill material.

3.5 TOLERANCES

A. Top Surface of backfilling vegetation areas or areas to receive subsequent fill: Plus 0.15 foot, but do not create ponding.

B. Top Surface of backfilling areas to be surfaced with aggregate or concrete construction: Plus or minus 0.05 foot.

3.6 COMPACTION TESTING

A. Compaction testing, as required, will be performed in accordance with ASTM D2922 or ASTM D4253 as applicable.

3.7 SCHEDULE OF LOCATIONS

A. The paragraphs below identify location, fill material to be used, and density expressed as a percentage of maximum density in comparison with ANSI/ASTM D698.

B. Pipe bedding: Select subsoil fill compacted to 95 percent standard proctor

END OF SECTION

SECTION 02230

HORIZONTAL DIRECTIONAL DRILLING RIVER CROSSING

PART 1 GENERAL

1.1 WORK INCLUDED

A. This section covers the installation of a two (2) inch diameter HDPE duct beneath the Mosquito Creek, Council Bluffs, Iowa.

B. Horizontal directional drilling involves the creation of a small-diameter (typically 2"-4") borehole using a steerable, fluid-jet-assisted, mechanical cutting tool. The borehole shall then be enlarged using a reaming assembly, to accommodate installation of the HDPE duct. The HDPE duct shall then be pulled through the enlarged borehole into its final position under the river.

C. The Contractor shall furnish all labor, materials, tools, equipment, drilling fluids, and other items as necessary for a complete and functional installation as required, to the lines and grades shown on the Drawings and as specified.

D. The Contractor shall not disturb the bottom or the banks of the river.

1.2 REFERENCES

A. ANSI/AWWA C-600.

B. HDD Bore Plan for Mosquito Creek Crossing I-29 Corridor, Council Bluffs, Iowa

1.3 SUBMITTAL DATA

A. The **HDD Bore Plan for Mosquito Creek Crossing I-29 Corridor, Council Bluffs, Iowa** is an integral part of this specification section. The project shall be completed in general conformance with the HDD Bore Plan. Submittal data required below shall follow the requirements as outlined in the HDD Bore Plan.

B. Submit the following data on Construction Methods and Materials:

1. Techniques that will be used, including a methodology statement detailing the operation of the equipment to ensure accuracy of the pilot bore and the installed duct and methods that will be used to monitor and control the installation loadings on the duct.

2. Material data including certifications for the HDPE duct and drilling fluid

additives.

3. Details regarding the type, capabilities, and use of the location system to ensure the duct is installed within the installation tolerances.

4. A sketch detailing areas and arrangements for staging areas, equipment set-up, equipment layout, storage, and all major supporting equipment.

B. Submit the following calculations:

1. Design calculations for alternative representative loading conditions for the duct during and subsequent to installation. Design calculations shall be presented in a neat, readable form, with all figures, values, and units presented clearly. Calculations shall clearly indicate the factor of safety for the pipe for all loading conditions. Calculations shall be made by the pipe manufacturer in cooperation with the Contractor. Calculations shall include the following as a minimum:

   a. HDPE pipe size.
   b. Wall thickness.
   c. Minimum allowable bending radius.
   d. SDR requirements.
   e. Anticipated loadings with factors of safety.

2. Calculations of other requirements such as tensile, compressive, bending, and torsional loads along with the capability of the equipment and drill pipe to withstand these conditions.

C. Submit the following data and drawings regarding the installation of the pilot bore and the duct:

1. Subsequent to installation of the pilot bore and before beginning pilot bore enlargement, submit a drawing detailing the installed location of the pilot bore in both plan and profile view. Document deviations required from contract drawings along with explanation of why deviation was necessary.

2. Submit written record of installation pullback loads monitored on the duct during the installation process.

3. Plan and profile drawings of the documented as-built condition of the duct crossing.

PART 2 PRODUCTS

2.1 GENERAL

A. Contractor shall be responsible for providing equipment and materials of sufficient size and capabilities along with adequately experienced labor as required for a complete installation in accordance with the contract requirements.

2.2 MATERIALS

A. Horizontal Directional Drilling Equipment shall have adequate thrust, pullback, and torque capabilities to successfully complete the crossing installation.

B. Location System shall be capable of tracking the position of the drill head at all locations during the pilot bore installation.

C. Drilling Fluid System shall be capable of mixing and delivering the drilling fluid to the drill head or the reamer in the volumes and pressures required.

D. Drilling Fluid shall be used as required during the installation of the pilot bore, enlarging of the pilot bore, and installation of the HDPE duct. Water used for the drilling fluid shall be potable water. Drilling fluid additives may be utilized as required by the Contractor, but shall be free of contaminants.

E. Drill Pipe (drill stem) shall be of sufficient size and strength to resist all installation loadings including tensile, compressive, bending, and torsional loads. An appropriate safety factor shall be used by the Contractor in sizing the drill pipe.

F. Drill Head configuration shall be as selected by Contractor and compatible with requirements for location system.

G. Reamer and Swivels shall be as selected by Contractor. Reamer and swivel assembly shall be capable of enlarging borehole while preventing rotation of HDPE duct during its pullback into its final position.

PART 3 EXECUTION

3.1 INSTALLATION

A. STAGING AND SET-UP

1. Contractor shall perform surveying for layout of crossing.

2. Contractor shall locate all existing utilities as required.

3. Contractor shall position and anchor drill unit as required. Proper setbacks shall

be provided to allow for installation of the duct at the locations indicated on the drawings and to avoid excessive steep entry and exit angles for the pilot bore and the installed duct.

4. Make necessary provisions for operation of location system.

B. BORING OF PILOT BORE

1. Install pilot bore using steerable drilling head.

2. Monitor location of drill head as required to install pilot bore to indicated lines and grades.

3. Use drilling fluids as required to lubricate and support the pilot bore excavation.

4. Pilot bore shall be free from abrupt changes in line or grade that could result in unacceptably high loadings on the drill pipe or the duct during installation.

5. After installation of the pilot bore and before beginning pilot bore enlargement, submit to Engineer a drawing detailing the installed location of the pilot bore in both plan and profile view. Document deviations required from contract drawings along with explanation of why deviation was necessary.

C. PRE-REAMING OF THE PILOT BORE

1. Subsequent to Engineer's acceptance of pilot bore, Contractor may, at his option, pre-ream the pilot bore hole as necessary for installation of the duct.

2. Use drilling fluids as required to lubricate and support the reamed pilot bore.

3. Use of pre-reaming shall be at the option of the Contractor, however, lack of pre-reaming shall not result in excessive installation loads on the duct.

D. REAMING AND PULLBACK OF THE DUCT

1. Contractor shall utilize a reamer to enlarge the pilot bore to sufficient size for installation of the duct without imposing excessive installation loadings on the HDPE pipe.

2. Contractor shall utilize a sufficient number of swivel mechanisms on the pull back drill string so as to prevent rotation or imposing torsional loadings to the HDPE duct.

3. Grippers used on the HDPE pipe shall not damage adjacent sections of the pipe. Sections of the pipe utilized by the grippers shall be removed from the pipe after installation of the pipe.

4. Contractor shall handle and support the HDPE duct so as to prevent damage to the pipe and minimize pullback forces.

5. Contractor shall use drilling fluids as required to lubricate and support the reamed pilot bore, lubricate installation of the duct, and completely fill all overcut of the reamed pilot hole.

## Section 2506. Flowable Mortar

### 2506.01 DESCRIPTION.

Place a flowable mortar fill material. Uses include, but are not limited to, placement under existing bridges, around or within box culverts or culvert pipes, in open trenches, or at other locations as shown in the contract documents.

### 2506.02 MATERIALS.

Meet the requirements for the respective items in Division 41 with the following exceptions:

**A. Cement.**

Meet the requirements of Section 4101.

**B. Fly Ash.**

Meet the requirements of Section 4108. Use fly ash from a source approved by the Engineer.

**C. Fine Aggregate.**

1. Use natural sand consisting of mineral aggregate particles or foundry sand from the castings of ferrous material. Use the gradation shown in Table 2506.02-1:

**Table 2506.02-1: Fine Aggregate Gradation**

| Sieve Size | Percent Passing |
|---|---|
| 3/4 inch (9.5 mm) | 100 |
| No. 200 (75 µm) | 0-10 |

2. It is intended that the sand be a fine sand that will stay in suspension in the mortar to the extent required for proper flow. For the Contractor's information, uniformly graded sand in the gradation range shown in Table 2506.02-2 has generally shown good flow characteristics when using the normal amount of fly ash (300 pounds per cubic yard (180 kg/m$^3$)). Concrete sand normally does not produce the desired flowability.

**Table 2506.02-2: Informational Gradation Limits**

| Sieve Size | Percent Passing |
|---|---|
| 3/8 inch (9.5 mm) | 100 |
| No. 8 (2.36 mm) | 80-100 |
| No. 16 (1.18 mm) | 60-100 |
| No. 30 (600 µm) | 45-80 |
| No. 50 (300 µm) | 12-40 |
| No. 100 (150 µm) | 1.5-25 |
| No. 200 (75 µm) | 0-5 |

3. Fine aggregate meeting the above informational gradation limits may be used in the basic proportions shown in Article 2506.02, E, without initial mix design, provided the flowable mortar is used in noncritical fluidity locations described in Article 2506.02, F. The Engineer reserves the right to reject the intended sand if a flowable mortar cannot be produced using the specified proportions.

4. The Contractor is not responsible for certified aggregate testing. The Engineer will provide appropriate inspection (normally, source approval) followed by visual inspection. If foundry sand is used, ensure it meets the requirements of IAC 567 Section 108. Ensure suppliers of foundry sand submit a processing plan to the District Materials Engineer for review and approval.

**D. Admixtures.**

Air entraining and water reducing admixtures may be added to increase the fluidity of flowable mortar.

**E. Mix Design.**

1. Use the basic proportioning for flowable mortar shown in Table 2506.02-1:

**Table 2506.02-1: Quantities of Dry Materials Per Cubic Yard (Cubic Meter)**

| | |
|---|---|
| Cement | 100 pounds (60 kg) |
| Fly Ash | 300 pounds (180 kg) |
| Fine Aggregate | 2600 pounds (1545 kg) |